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ABSTRACT

This paper examines possible interchanges between cognitive and language processes with particular attention given to concept formation and semantic language development. Aspects of psychological and contemporary linguistic theories are discussed as a way to interrelate the functions of thought and language. The author concludes that while language is subordinate to fundamental thought processes, language ought not be regarded as a passive instrument operating on behalf of the intellect. Through correct application of linguistic rules, concepts seem to be fully expressed when words are joined in sentences. However, the ability to encode and decode words in sentences depends ultimately on seeing single words as concept labels. Language and concept formation are so interwoven that their precise interrelationships are difficult to define. Because of the similarities between the two, it is proposed that the acquisition and development of word meaning be reformulated in verbal concept learning terms, while the relationship governing words be treated in the framework of language development. (Author/DI)

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Theoretical Paper No. 37

CONCEPT FORMATION AND THE DEVELOPMENT OF LANGUAGE

by

Gordon K. Nelson

Report from the
Operations and Processes of Learning Component of Program 1

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Statement of Focus

The Wisconsin Research and Development Center for Cognitive Learning focuses on contributing to a better understanding of cognitive learning by children and youth and to the improvement of related educational practices. The strategy for research and development is comprehensive. It includes basic research to generate new knowledge about the conditions and processes of learning and about the processes of instruction, and the subsequent development of research-based instructional materials, many of which are designed for use by teachers and others for use by students. These materials are tested and refined in school settings. Throughout these operations behavioral scientists, curriculum experts, academic scholars, and school people interact, insuring that the results of Center activities are based soundly on knowledge of subject matter and cognitive learning and that they are applied to the improvement of educational practice.

This Theoretical Paper is from the Project on Variables and Processes in Cognitive Learning in Program 1, Conditions and Processes of Learning. General objectives of the Program are to generate knowledge and develop general taxonomies, models, or theories of cognitive learning, and to utilize the knowledge in the development of curriculum materials and procedures. Contributing to these Program objectives, this project has these objectives: to ascertain the important variables in cognitive learning and to apply relevant knowledge to the development of instructional materials and to the programming of instruction for individual students; to clarify the basic processes and abilities involved in concept learning; and to develop a system of individually guided motivation for use in the elementary school.

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Abstract

This paper examines possible interchanges between cognitive and language processes with particular attention given to concept formation and semantic language development. Aspects of psychological and contemporary linguistic theories are discussed as a way to interrelate the functions of thought and language. It is concluded that semantic growth is largely a matter of verbal concept learning.

I
Introduction

Language is a cognitive enterprise. Its acquisition depends quite heavily on the support given by maturating mental processes that are found only in man; lower and more primitive organisms lack these faculties for acquiring language. In some cases of lower primates, where animal communication systems resemble that of homo sapiens, we can correctly infer the existence of speech. However, it would be a mistake to identify this type of behavior as language. Speech is overt behavior; it is the ability to produce recognizable sounds. Language, on the other hand, is a species-specific kind of activity which entails knowledge of rules of linguistic structure accompanying speech behavior (i.e., the speaker-hearer's knowledge of his language). Lenneberg (1967) describes man's innate faculté de langage as a product of deeply-rooted evolutionary and biological processes.

Concept formation is likewise cognitively based and specific to man. Except for a small repertoire of reflexive associations that, for the most part, have been instilled by intensified practice, organisms below man do not manifest conceptual behavior at an advanced level. Concept formation, like language, is deeply rooted in man's biological nature.[1]

The study of language traditionally has been the exclusive domain of scholars in the fields of linguistics and language philosophy. A survey by Carroll (1955) revealed that only in recent years have language studies differentiated into numerous distinct disciplines. Miller (1964b) has reminded us that psycholinguistics, for example, is still a relatively "new science," the central task of which is to explain the psychological processes involved when people use sentences. The previous practice of insulating the study of language makes it easy (and quite convenient) to conceive of some separate language capacity operating within man, exclusive of cognition. To circumvent this pitfall, the present inquiry has been undertaken as an attempt to identify important cognitive factors underlying the relationship between language development and concept development. In this presentation attention will be focused on the role of language in cognition. The task that has been set forth seeks to accomplish two specific goals: (a) to determine in what ways the language apparatus might facilitate and complement conceptualization, and (b) to delineate common characteristics of language and concept development.

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[1] Premack (1971) has recently reported some interesting findings in teaching language to chimpanzees. There is some evidence to suggest that these lower primates can engage in some productive forms of symbolic activity. However, the impact of this symbolic activity remains to be seen before there is any recasting of the theories of cognitive species-specificities.

II
Words, Concepts, and Objects

The familiar "Original Word Game" of Roger Brown (1958) describes how one learns to speak a language. The game is played by one who knows the language (the tutor) and by one who is learning the language (the player). The tutor names things in accordance with the linguistic customs of his community, and the player observes the tutor's performance in order to gain information about equivalences. The player's role is essentially that of formulating and testing hypotheses about the nonlinguistic categories giving rise to certain utterances.

By participating in this kind of game, the language learner soon realizes that words are not used to label specific things, but rather are used to designate classes of things. Even when observing language learning experiences from the outset, one is struck by a child's propensity to overgeneralize. The word daddy, for instance, is often used by a very young child to signify people or men other than the child's father. Only later is the child able to make the correct distinction between what he calls his father and what he calls other people. But even then the young child will come to realize that other people can also be signified by the same label because they are entitled to it.

Labeling is not a rigidly fixed convention governing the relationship between specific words and objects. Labeling reflects a classificatory scheme or categorization process by which objects, events, and relations in the world are assigned a common label, as when certain objects fulfill necessary criteria to be called "cars," for example. The relationship is well articulated by Lenneberg (1967) who refers to concept formation as the primary cognitive process, and naming (as well as acquiring a name) as a secondary cognitive process subsumed under concept formation.

A classic illustration outlining the relationship among words, concepts, and objects may lend further clarification. Ogden and Richards (1923) formulated what they called a "triangle of reference," which is shown in Figure 1. This configuration is comprised of three components: thought (or "interpretation"), symbol (words), and referent (thing or object). Thought, or what Ogden and Richards called "interpretation," is synonymous with concept formation since it is defined as the psychological process that occurs when one relates a symbol and a referent. While the connections between thought and symbol and thought and referent are direct, the connection between symbol and referent must be indirect—and thus is represented by a dotted line in Figure 1. To recapitulate, the relationship between words and things is arbitrary; it is not fixed.

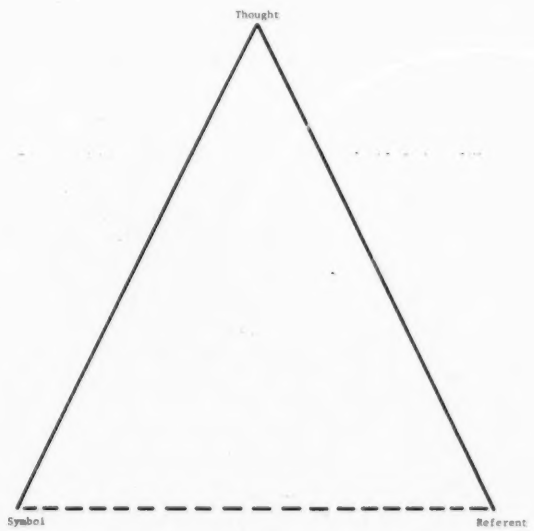

Fig. 1. Representation of the relationship among words (symbol), concepts (thought), and objects (referent). (Adapted from Odgen & Richards, 1923, p. 11.)

Lenneberg (1962), on the other hand, schematized the interrelation among language, concepts, and the physical world (objects) as shown in Figure 2. These diagrams circumscribe the three related areas and represent the important distinction between "universals" and "particulars" of language. As Diagram I indicates, concepts do not have the same boundaries as objects, nor does language have the same boundaries as concepts or objects. Generally speaking, language reflects only a part of the conceptual world of the language user. Language can, however, be extended to any area in the concept realm by creation of new terms. Diagrams I and II illustrate how two languages (A and B) might draw different samples from the realm of concepts, and Diagram III illustrates the relationship these languages bear to one another. In Diagram III, the area of A not represented in B (i.e., A - B) indicates semantic features of language A which are not found in language B. Similarly, B - A would indicate semantic features found in language B but not in language A. The intersection of these two languages ($A \cap B$) reflects phenomena (universals) that are shared by both.

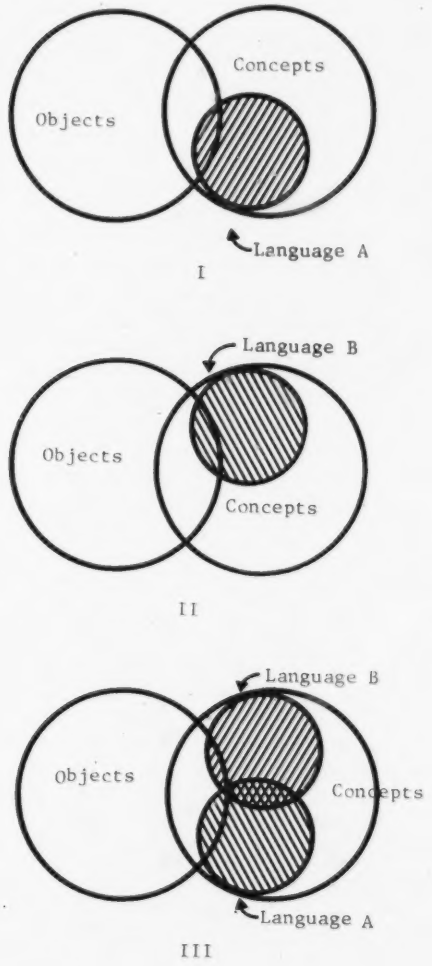

Fig. 2. Lenneberg's conception of the theoretical relationship of concepts, the physical world (objects), and languages. (Adapted from Lenneberg, 1962, p. 107.)

Lenneberg points out that the semantic differences between languages may be very small compared to the overriding isomorphism. Quite possibly, all languages deal with roughly the same concepts, but leave many concepts unnamed. Universals (i.e., features shared in many languages) are of interest in some language studies, particularly anthropological investigations. An excellent general discussion of language universals can be found in the book, Universals of Language (Greenberg, 1963), which also contains thought-provoking articles by Ullman (1963) and Weinreich (1963) dealing specifically with semantic universals.

Thought and Language: The Question of Antecedence

Discussion in the last section suggests, inter alia, that language reaches into only a part of the conceptual realm. Conceptual behavior apparently develops and proceeds even in the absence of language activity. If this is the case, perhaps language is more dependent upon thought than thought upon language. In this section, we will examine closely the issue of their relative importance.

The association between language and intellectual operations has captured the interest of psychologists for a long time. This interest was rekindled by the writing of two renowned cognitivists of the 1920's, Lev Semenovich Vygotsky (1962) and Jean Piaget (1926). Vygotsky saw language and thought development (both phylogenetic and ontogenetic) as emerging from two separate lines, converging at the stage of "egocentric speech" (about age two), and then separating again but not without some continued mutual influence. According to Vygotsky's theory, a point is attained in the course of development where language becomes "internalized" and becomes an intricate part of the cognitive machinery ("inner speech"). Piaget has disputed Vygotsky's

analysis because of the heavy emphasis placed on language which, under this kind of interpretation, becomes tantamount to thought. For Piaget, language plays only a subordinate role to thought processes; it is not a sufficient condition for conceptual activity. Moreover, the source of cognitive operations is found not in language, as implied by Vygotsky's statements, but in the preverbal sensorimotor period of intellectual development.

Studies of the Deaf

Assuming that language has a vital influence on cognitive behavior, we would expect the conceptual development of the congenitally deaf to be severely impaired. Reports on deaf people's performance on cognitive tasks, however, do not bear this out (Furth, 1961, 1964a; Kates, Kates, & Michael, 1962; Kates, Yudin, & Tiffany, 1962; Lenneberg, 1964, 1967; Michael & Kates, 1965; Oleron, 1953). Furth (1961), for example, has reported that children who are deaf and who are severely limited in their ability to speak, read, or write English demonstrate no significant differences from normal hearing children in most fundamental cognitive abilities. Kates, Kates, and Michael (1962) performed a series of categorization experiments with deaf adolescents and deaf adults which supported the view that thought is possible without, and prior to, language. Lenneberg (1967) also found that preschool deaf children differ in no respect from hearing children on the Leiter scale, a language-free concept formation test.

Furth points out the important implications of these studies for inferring the influence of language on intellectual development. He concludes:

> (a) Language does not influence intellectual development in any direct, general, or decisive way. (b) The influence of language may be indirect or specific and may accelerate intellectual development: by providing the opportunity for additional experience through giving information and exchange of ideas and by furnishing ready symbols (words) and linguistic habits in specific situations.
>
> From this position it should follow that persons deficient in linguistic experience or skill (a) are not permanently or generally retarded in intellectual ability, but (b) may be temporarily retarded during their developmental phase because of lack of sufficient general experience and (c) they may be retarded on certain specific tasks in which available word symbols or linguistic habits facilitate solution [1964b, p. 160].

While language may not predominate over cognitive activity as once believed, it remains to be seen how it might exert the indirect influence suggested by Furth.

Language-Influenced Cognitive Development

Because of a dearth of empirical data, the degree to which language might indirectly influence cognition is yet to be determined. Five possible sources of influence are mentioned by Bruner, Olver, and Greenfield et al.

> (a) the use of words as invitations to form concepts; (b) contingent dialogue between adult and child; (c) the importance of "school" as an innovation; (d) the development in a culture of "scientific" concepts; (e) the possibility of conflict between modes of representation [1966, p. 62].

Only the first of these points, dealing with the child's active pursuit of the meaning of unfamiliar words, has been the target of any concentrated research. Spiker, Gerjuoy, and Shepard (1956) found that young children who could use some form of the verbal concept "middle-sizedness" performed significantly better on a relational task than children who did not possess this concept. In a study by Brown and Lenneberg (1954), a high correlation was noted in codability of colors and their recognition on subsequent tasks. A classic experiment by Carmichael, Hogan, and Walter (1932) found that when subjects were briefly presented with an array of ambiguous figures and later asked to reproduce them, reproductions conformed to the verbal labels which were assigned upon presentation. Verbal labels were believed to be more easily stored in memory than the ambiguous images themselves. In a more recent experiment, Fredrick and Klausmeier (1968) demonstrated the advantages of verbal coding in a concept attainment task using geometric figures. Their data showed that subjects who were given meaningful labels performed significantly better than subjects who were given nonsense labels. Meaningful labels functioned as verbal signs to indicate that commonality existed, thereby initiating

conceptual activity. Other such studies are reported by Carroll (1964a).

The implications of these studies for appraising the weight of language in conceptual development is still largely an unsettled matter. Discrepant findings have been cited by other researchers. Rasmussen and Archer (1961), for example, gave language pretraining to some subjects before they were asked to identify nonsense shapes. To a similar group of subjects, they gave aesthetic pretraining in which the same stimulus patterns were to be judged according to the degree of "pleasantness." The results indicated that the latter group performed significantly better than the language pretraining group on subsequent concept identification. In explaining this unexpected finding, the authors suggested that the language pretraining led subjects to respond only to the shape dimension and to ignore other dimensions noticed by the aesthetic pretraining group.

Despite the reported inconsistencies which seem to relate to the nature of the experimental tasks, a parsimonious position such as that posited by Carroll (1964a) might be taken; that is, the effect of language is "to make the difference among stimuli more noticeable, or salient, than they would otherwise be [p. 98]." Common labels, on the other hand, may draw attention to commonalities.

III
Conceptualization and Contemporary Linguistic Theory: Mentalism in Linguistics

The once dominant taxonomic approach to language study typified by Bloomfieldians (see Bloomfield, 1933) has been a waning influence on the study of linguistics since the 1950's. Based on a system of taking utterances and breaking them down by classificational procedures, this school of linguistics has always dismissed any consideration for the mental processes underpinning language. The mentalistic conception in current linguistic theory has improved over the previous generation by giving serious attention to cognition and related issues.

Not only does current theory attempt to cast language in a proper perspective in relation to cognition, but it also helps further psychological research. Arguing in defense of the superiority of a mentalistic conception of linguistics, Katz (1964) states that since psychologists and linguists are both constructing theories related to the neurophysiology of the human brain, it behooves linguists to harmonize their theories with those of the psychologists who deal with other human abilities. Furthermore, he claims, a mentalistic conception provides a psychological reality for necessary features of natural language and thus has implications for the psychology of human language learning.

There is really no theoretical dichotomy existing between cognition and language in the linguistic theory of Noam Chomsky (1966, 1968a, 1968b). Chomsky views language as a kind of latent structure in the human mind. Language provides "finite means but infinite possibilities of expression constrained only by rules of concept formation and sentence formation [1966, p. 29]." The mind acts through an internalized system of many rules that are organized by certain fixed principles. This system of rules is a "generative grammar" and the theory which accounts for how these rules are applied has become known as "transformational generative grammar."

The generative grammar outlined by Chomsky specifies the relationship between sound and meaning. In theory, the mind takes a corpus of actual utterances and attempts to discover the relationship among the various words (i.e., the syntax); then the mind, given a "deep" representation or "underlying mental reality" of the acoustical signals, determines the meaning. "Deep structure" is the "mental accompaniment" of an utterance. Distinguished from surface structure (i.e., a representation of the phonetic units of utterances), it is a "purely mental" structure composed of a system of organized propositions contributing to the determination of meaning.

The finer points which deal with the formal operations relating surface structure to deep structure are discussed elsewhere by Chomsky (1957, 1965). The main point of emphasis is that modern linguistics cannot be divorced from a mentalistic framework.

Chomsky's descriptions dealing with innate mental capacities have proved to be very interesting for psychology. While Chomsky (1959) has defended his nativistic viewpoint well vis-à-vis traditional S-R theory,[2] the extent to which modern cognitive psychologists will accept Chomsky's theories in regard to the development of conceptual behavior remains to be seen. Piaget (1968), for example, generally agrees with Chomsky's theoretical descriptions, particularly where language is grounded in the cognitive domain, but finds the concomitant nativism "too heavy-handed." Piaget cannot accept the

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[2]See also Fodor (1965), an adherent of Chomsky's generative theory, who exposes mediational models as reducible to single-stage S-R theory.

claim of a "fixed innate schema." Instead, he postulates an equilibration model ("the third alternative") which lies somewhere between innatism (preformation) and social formation. This model is based on the idea that language, as well as general symbolic activity, develops by structure formation. Early and more primitive structures evolve into highly complex ones through processes of assimilation and accommodation. The individual, as an equilibrating agent, is continually in active balance with his environment.

There are no a priori reasons, as McNeill (1970b) has suggested, to doubt the legitimacy of theories such as those of Piaget. The problem of deciding which theories of language development are appropriate is a matter left to future empirical research. At any rate, there is no denying that the impact of Chomsky's theories is presently being felt in research on cognitive development. Chomsky's influence, for example, is very evident where the "competence-performance" distinction is made. The notion of "competence" refers to the language user's knowledge of the rules and categories of his language; "performance" refers to his language behavior—encoding and decoding sentences in concrete situations. Flavell and Wohlwill (1969) describe the work of a group of psychologists at the University of Minnesota Center for Research in Human Learning who are developing an approach to theory construction in psychology that elaborates this distinction. These psychologists contend that a psychological theory of complex human behavior should have two components: a "competence" model and an "automaton" model (akin to Chomsky's notion of "performance"). A competence model, as they see it, would be "a formal, logical representation" of some cognitive structure (what the organism knows), while an automaton model would represent "the psychological processes by which the information embodied in competence actually gets accessed and utilized in real situations [p. 71]." Without the formulation of a competence model, the researcher in cognition would be seriously neglecting the theoretical foundation of observed performance (automaton).

Semantic Theory

Semantic development is perhaps the least understood aspect of the acquisition of language. Linguists, long concerned with the problem of how the language user constructs and cognizes meaning from the organization of words, are only now beginning to attack the problem with moderate success (Katz, 1966, 1967; Katz & Fodor, 1963; Katz & Postal, 1964; Weinreich, 1966). The meager success that has been achieved recently is undoubtedly a consequence of the realization that the semantic component of language cannot be treated in isolation as were phonology and syntax. Semantics goes far beyond language itself. It will be shown in this section (and the section immediately following) that semantics and semantic development are of special relevance to concept learning. The best way to begin is to examine the scope and present knowledge of semantic theory.

A semantic theory, according to Katz and Fodor (1963), explains the language user's ability to produce and understand novel utterances at the point where grammar stops. "In general, it is obvious that in no sense of meaning does the structural description which the grammar assigns to a sentence specify either the meaning of the sentence or the meaning of its parts [p. 173]." A semantic theory is said to have two parts: a dictionary component and "projection rules." A dictionary provides meaning for each of the lexical items of a sentence, whereas the projection rules assign an interpretation to a string of formatives (i.e., a derived reading of combined words). We will begin with a description of the dictionary component and return later to the notion of "projection rules."

The dictionary contains "entries" that are assigned to each word or morpheme in a sentence. These entries furnish pieces of information contributing to the meaning of each word by stringing a list of symbols or features. In this fashion, the meaning for each lexical item can be decomposed into elementary parts. This has been a traditional practice among concept learning researchers (see Klausmeier & Harris, 1966). The terminology used by scholars in the area of concept learning, however, is a little different: "words" and "features" are referred to as "concepts" and "attributes."

When a number of entries are attached to a word, the result may be represented semantically by a concatenation of symbols. Taking the lexical item tree, for example, the following representation can be rendered:

TREE → Noun → (Physical Object) →

(Living) → (Large) → (Stationary) →

[a Kind of Plant]

The path for tree contains a syntactic marker (Noun), semantic markers (Physical

Object, Living, Large, Stationary), and a "distinguisher" (a Kind of Plant). The semantic markers serve to designate the relevant attributes for the word, while the distinguisher, which is optional, gives additional descriptive information when "no systematic conceptual distinction" is in the language.

The ordering of semantic markers is an important aspect in this schematization, and only recently has ordering been given explicit attention in semantic theory (see Katz, 1967). The intent of this ordering is such that the arrangement will always be a hierarchical one: higher markers predominate over the lower markers; that is, semantic markers which precede other markers are considered to be more general. Miller (1969) speaks of this relationship as "feature dominance." While the features or attributes for the example given (viz., tree) are not precisely ordered in Miller's terms, they nevertheless indicate the kind of relationship that is sought.

> Semantic markers must, therefore, be thought of as theoretical constructs introduced into semantic theory to designate language invariant but language linked components of a conceptual system that is part of the cognitive structure of the human mind [Katz, 1967, p. 129].

Not all words, of course, have one distinct sense (one path); many words are filled with multiple senses which can be represented in the form of a tree diagram. The example of bachelor can be represented as having four distinct senses (four paths)—thus four-ways semantically ambiguous—and is diagrammed by Katz and Postal (1964) as shown in Figure 3.

The remedy to disambiguate multiple-sense words like bachelor rests with the "projection rules." They make it possible to determine the correct usage for a word when it is combined with other words "by taking the Boolean union" of their semantic markers. For example, if we know that bachelor is combined with the modifier sea animal, to give us sea animal bachelor, three of the four senses of bachelor can be eliminated immediately, leaving us, of course, with only that sense denoted by the features: Animal - Male - Young - Seal - When without a mate during the breeding time.

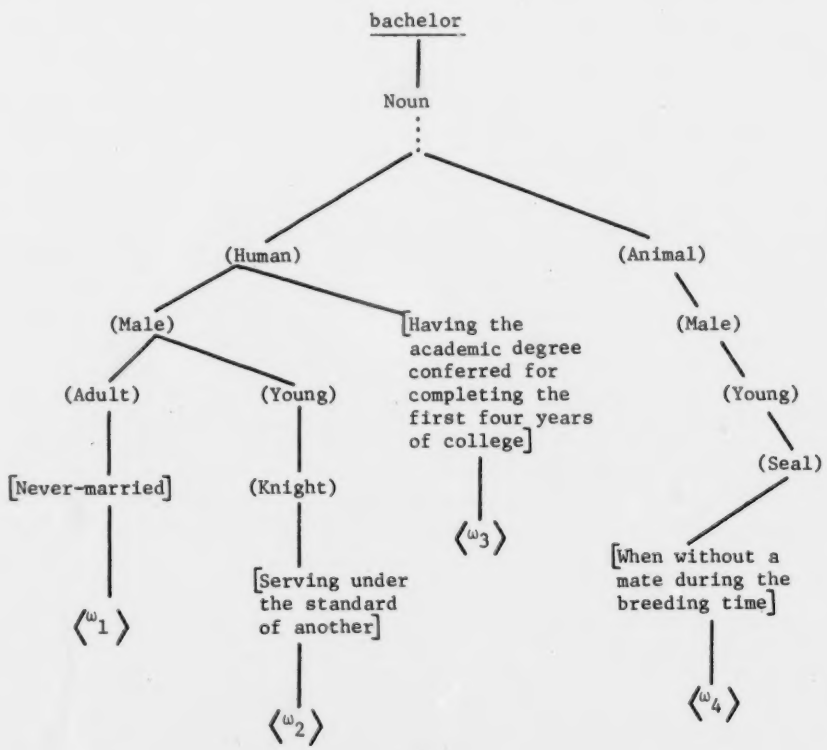

Fig. 3. A semantic characterization of the concept bachelor. (Katz & Postal, 1964, p. 14.)

Projection rules are also available for meeting other kinds of relationships such as subject-predicate, verb-object, etc. Ordinarily, multiple senses of a word can be reduced by objective criteria when a word satisfies the impinging selection restrictions in combining with other words. Any words that are brought together must demonstrate congruence between the paths of semantic markers in order that the words be interpreted as semantically meaningful. The verb eat, for example, is normally received by a physical object and thus will contain the selection restriction, characterized by angle-enclosed notation, of ⟪physical object⟫.

> Projection rules thus enforce selection restrictions by blocking all combinations where a reading does not contain the semantic markers necessary to satisfy the selection restriction in another [Katz, 1967, p. 128].

Semantic theory is still in a rather primitive state of development. This is true in view of the linguistic and extralinguistic factors which have not been dealt with satisfactorily. On the linguistic side, semantic theory has not devoted adequate attention to the role of syntax as a supplier of relevant semantic information (see Fillmore, 1968; McCawley, 1968). Fillmore, for example, who recently reintroduced the grammatical notion of "case," has shown us that semantic information is frequently overlooked in the relationship between subject and predicate. Some of the relationships he describes are: agentive, instrumental, objective, factitive, locative, and benefactive.

On the other hand, extralinguistic considerations of reference, context, intended ambiguity or metaphor, and change of word meaning have not been handled suitably in semantic theory (see Deese, 1967; Lakoff, 1970a, 1970b; O'Connell, Kowal, & Hormann, 1969; Olson, 1970). Interpretation of statements can be hindered in many situations without an appeal to some of these factors.

Psychological Processes

These related issues of semantic theory are, for the most part, incidental to our main discussion and we mention them only in passing. What needs to be emphasized are the conceptual processes reflected in semantic theory. Such a theory, as we have seen, is not just an explanation of how the human organism by exercising his competence of language is able to interpret utterances, many of which happen to be novel. Rather, a semantic theory can be envisaged as a model of concept utilization in the language arena; that is, a model of how one is able to make virtually infinite use of the concepts (words) he has acquired. Concept formation itself can be viewed as the process of learning the semantic markers (attributes) for words (concepts). We will take up the learning of semantic features more explicitly in the next section.

Once the tools of concept formation and sentence formation (grammar) have been learned, the individual in his role as language user can make infinite combinatorial use of the finite number of words he knows. He can encode and decode many unfamiliar strings of utterances. The procedure is roughly that of building upon the elementary parts of a sentence, giving them representation, and linking these integral parts to the next higher level of structure until finally an organic whole is obtained. We can only speculate at this time how the process works.

Take, for example, the sentence Nearby is the house on the hill. Decoding this sentence consists of analyzing two propositions separately: "the house is on the hill" and "the house is nearby." Using Chomsky's form of diagrammatic notation, the deep structure of these two propositions can be represented in either of two ways as shown in Figures 4 and 5. The task of the language user is to apply his concept knowledge by taking the lexical items found in the sentence, amalgamating the elements into two propositions, translating each proposition separately, and interrelating them both. The final output

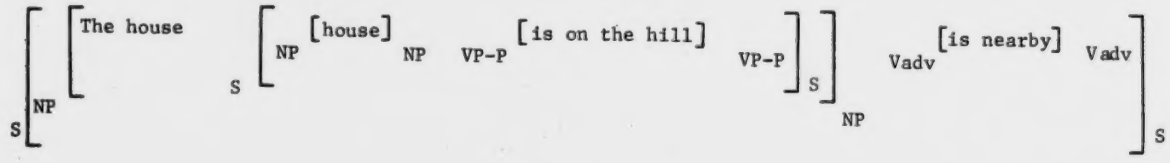

Fig. 4. A representation of the deep structure of the sentence Nearby is the house on the hill.

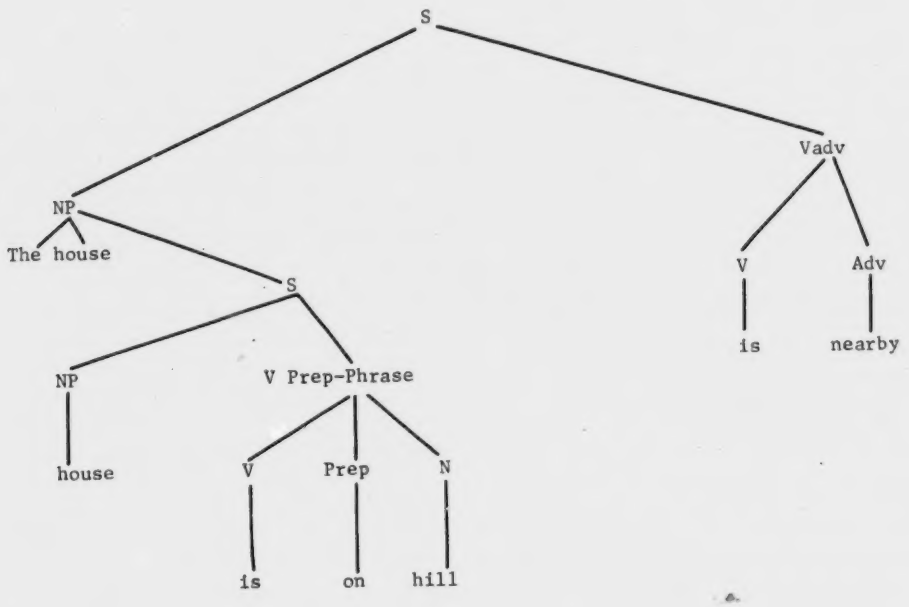

Fig. 5. An alternate form of representing the deep structure of the sentence Nearby is the house on the hill.

is an interpretation covering the entire sentence.

Two additional aspects implicated in this process of building upon concepts should be noted. First, each lexical item (concept in this case) need not be cognized in order to obtain a semantic interpretation of the sentence. This is true for two reasons: (a) Not all elements carry semantic information—prepositions, conjunctions, and articles are a few examples. To use Slobin's (1971) illustration, what idea or thought does the word the convey or arouse in you? Very little indeed! This does not mean that such words are meaningless, but rather they serve exclusively a grammatical function and thus have "syntactic meaning." And (b) it is evident from some psychological investigations (for example, Werner & Kaplan, 1950) that the language user can frequently interpret sentences when he does not have a concept or, perhaps, has a distorted concept that is embodied in a word. One can often ignore certain words, such as modifiers, that are not understood, and still be able to interpret correctly the meaning of a sentence.

Nor should it be inferred that the process of joining and relating concepts and propositions is a conscious one. For reasons like those cited above, there are words which we are unable to call up and dwell upon in our mind. Also, in view of the rapidity with which we process information, it is inconceivable that this process must be a conscious one.

Rules

Finally, while exercising some caution, we might extend our analogy of concept learning and language learning to include rules or principles. We have seen that words are combined and arranged sententially by observing syntactical (grammar) and semantic constraints (e.g., projection rules). Word groupings that do not obey these rules usually turn out to be anomalous constructions. In the same sense, we can speak broadly of the regulatory nature of conceptual rules, which seemingly serve a generic foundation for the specific rules of linguistics. Conceptual rules describe the relationship among the relevant attributes of a concept. Bourne (1968), who analyzes the similarities of verbal and conceptual structures, sees semantic and syntactic rules as the vehicle for governing "the meaning either of single words or of word sequences," which is similar to the function of conceptual rules "for generating sensible stimulus groupings." Bourne writes:

> Just as linguistic rules, once learned, provide a means for generating and for understanding completely new and unpracticed words or sentences, conceptual rules are likely to underlie the production of new concepts which are nonetheless appropriate in novel situations and problems [1968, p. 234].

Once again, we find another important avenue for establishing a close relationship between language and conceptual processes. It is not surprising to find the work of linguists converging with that of psychologists. Of late, there has been a great deal of mutual interest from the two fields where rules are concerned. As George Miller puts it:

> ...both must work shoulder to shoulder—the linguist trying to test his formulation of the rules of the language, the psychologist trying to test his formulation of the psychological processes whereby the language user succeeds or fails in obeying these rules [1964a, p. 94].

When we speak of rules, whether they be linguistic in nature or the general conceptual rules for grouping, we do not mean prescribed laws like those found in traditional established grammars (e.g., rules against dangling modifiers). Rules are descriptive and often inexplicable by the one using them. They may best be thought of as hypotheses "to account for observed regularities [Miller, 1970, p. 191]." For example, conjunctive or disjunctive rules such as round and large and yellow, square and/or small and/or blue, etc. may account for regularities in sorting on a concept learning task. Rules describe the concept as having a particular combination of the attributes. The combinations are regulated by the rules of "and" and "and/or."

IV
The Formation of Concepts in Language Development

The discussion that follows is based on an hypothesized model of semantic development proposed recently by McNeill (1970a, 1970b). Although this model was intended for tracing the approximate course of development in children's acquisition of word meaning, it will be used here in order to relate semantic growth to concept learning, as well as to draw closer ties between language and thought.

McNeill speaks of semantic growth in children by figuratively comparing it to the compilation of a dictionary. Initially, the child (18 months) uses words holophrastically; words become paired with multiple sentence-meanings. The word milk, for example, might mean several different things to the young child: "I want some milk," "Get me the milk," or "My milk cup is empty." Words, in this sense, are more diffuse in meaning for the child than they are for adults (McNeill, 1966a). These words "telegraph" speech by conveying more information than that which is usually represented by a single word (Brown & Fraser, 1963). Thus we can think of the child's earliest semantic experience as one of compiling a "holophrastic dictionary." The problem with this kind of dictionary, however, is that it is open to a huge amount of ambiguity and is "burdensome for a child's memory." Inevitably, it must be dropped. In its place, a new dictionary can be created where words are paired with "single sentence-meanings," thereby diminishing much of the ambiguity. Using the same example of milk, the word might now reflect only one of the three possible sentence-meanings. However, even the task of compiling a dictionary of this sort must soon be dropped since it does not alleviate the heavy burden placed on memory. The ultimate solution, according to McNeill, is the compilation of a "word dictionary" which has the effect of a "sentence dictionary" but not the bulk.

The significance of a word dictionary lies in the nature of its entries. The child amasses a repertory of words by the special attention he gives to semantic features (i.e., attributes of words) and to the rules that regulate the use of dictionary entries. An entry from a word dictionary would have three characteristics: a syntactic feature giving parts of speech (e.g., noun, verb, adjective, etc.), semantic features (e.g., physical object, living, small, etc.), and selection restrictions governing the relationship between words so that proper combinations are made. These entries, it might be noticed, are not too different from what is found in the dictionary component of Katz and Fodor's (1963) semantic theory.

McNeill (1970a) offers two hypotheses—neither of which is mutually exclusive—to account for the enlargement of a word dictionary: "horizontal development" and "vertical development." Horizontal development refers to a sequential accretion of the semantic features of words. When words enter into the vocabulary of a child, there is a slow process of learning the semantic features or relevant attributes associated with a word. Words—that is, verbal concepts—do not have the same number of relevant semantic properties for younger children as they do for older children and adults.

Semantic development or dictionary enlargement is also thought to proceed along vertical lines (vertical development). Semantic features already may have been established in the child's dictionary before new words enter, but these features have not as yet been extended to the new words. In the instance of horizontal development, which probably occurs earlier than vertical, the characteristic properties of new words are slowly learned. Vertical development suggests that as new words enter, learning is not so much a matter of acquiring new defining attributes as it is of applying to new words the properties of already-established words. Semantic development in this case occurs by unification

of semantic features.

Presently, there are insufficient data to confirm the exact nature of semantic development or what we might call the qualitative growth of verbal concepts. Some support exists, however, to entertain the idea of horizontal development. Vocabulary studies tend to show that with increasing age children learn additive features or attributes for defining words (Al-Issa, 1969; Russell & Saadeh, 1962).[3] As children grow older, they appear to recognize more of the abstract properties of words than ever before. There is also some evidence of horizontal development in the equivalence studies by Bruner and his fellow investigators (Bruner et al., 1966). In these studies children have been found to group objects according to superordinate features more frequently with increasing age. As they grow older, children apparently gain valuable additional semantic information about words of which they already have some previous rudimentary knowledge.

Another fiber of evidence for horizontal growth can be established on the basis of the syntagmatic-paradigmatic shift in children's word associations (Brown & Berko, 1960; Entwisle, 1966; Entwisle, Forsyth, & Muss, 1964; Ervin, 1961). Briefly, syntagmatic responses occur in children under six years of age. During this time children are known to respond to a stimulus word with a word of another part of speech, forming a sequential or syntactic unit (e.g., "deep" - "hole"). Older children, beginning somewhere between six and eight years of age, respond to a stimulus word with a word of the same part of speech, thus creating a substitutional pattern (e.g., "below" - "down"). These studies (particularly Entwisle, 1966) have found that as children become older, new features are attached in paradigmatic responding. This has been interpreted to mean that with increasing age, children add semantic markers to words with which they are familiar. McNeill (1966b) places a strong emphasis on this particular interpretation. Deese (1965) also notes in his word association studies that new elements (attributes) are gradually assimilated in a piecemeal way.

To the best of the writer's knowledge, there is no tangible evidence to suggest that semantic development has also a vertical dimension. McNeill seems to be describing in this instance a kind of filing system that enables the individual to connect commonly shared attributes to many different concepts. The closest approximation to this type of development occurs in concept learning, in which new words are sometimes defined in familiar terms. For example, an unfamiliar concept such as trapezoid can be defined by more familiar attributes: four-sided, closed figure, having one pair of parallel sides. If it is true that such a cognitive phenomenon exists, it is then reasonable to suspect that vertical alignment in the word dictionary ensues only after horizontal development has begun, since vertical alignment presupposes that the attributes have already been established and horizontal development does not make this assumption.

Concept formation appears to be the basic cognitive process underlying semantic development. Words can be treated as verbal concepts whereby the child gradually learns their defining attributes. In McNeill's account, we have seen that word growth is not simply a matter where lexical items are introduced into a child's vocabulary. We know, for instance, that a child who is able to use words does not necessarily understand the concepts behind them (Brown, 1958). Only when the attributes or semantic markers accrue in sufficiently large numbers and the word can be used correctly in new instances do we say a child actually possesses the concept. Perhaps it is in this same sense that Carroll (1964b) said, "in the course of a person's life [concepts] become more complex, more loaded with significant aspects [p. 183]."

Again, we reaffirm that this growth is a slow process. While McNeill believes that semantic development does not begin until approximately 18 months of age; recent studies by Anglin (1970) and Entwisle (1966) suggest it is not completed until approximately 18 years of age. It is plausible that a long period of growth is involved, since concept learning occupies a large and substantial part of one's life.

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[3]The author has also found in unpublished research of his own that with increasing age children give more definitions including a greater number of attributes for environmental concepts (Grades: K, 2, 4, 6, and 8).

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V
Some Concluding Remarks

Preceding sections of this paper have attempted to show the interrelationship and possible ongoing exchanges between language development and concept development, emphasizing the preeminent role of cognition in both types of learning. Although language is subordinate to fundamental thought processes, we ought not to think of language as a passive instrument operating on behalf of the intellect. It is abundantly clear that language is a powerful force in its own right. Through correct application of linguistic rules, concepts seem to be given full expression when words are joined in a sentential environment. However, the ability to encode and decode words in sentence format depends ultimately on seeing single words as labels for concepts. Ultimately, the two become inseparable in human communication.

The relationship we have been treating throughout this inquiry is still largely an unsettled matter and certainly demands further psychological and linguistic investigation. In the attempt to understand the dynamics underlying man's knowledge of his natural language and the role of language in conceptual behavior, we find ourselves speaking in highly theoretical and much too speculative terms at this time. Semantic development is in need of particular attention. Language and concept formation are so interwoven that the relative positions they occupy with respect to one another are very difficult to define. Generally speaking, conceptual knowledge provides input to language; language, in turn, uses these concepts for the encoding and decoding of sentences. Because of these striking similarities, it is proposed here that the acquisition and development of word meaning be reformulated in verbal concept learning terms, while the relationship governing words be treated in the framework of language development. In this way, the research in semantic development might progress more steadily toward an enriched and integrated theory.

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